

What is claimed is:

1. A charging voltage measuring apparatus for measuring a charging voltage V_s on the surface of a substrate on a substrate holding unit, comprising:

5 a measuring electrode, for forming an electrostatic capacity C_s with said substrate, being disposed on said substrate holding unit to make contact with or proximate to the back face of said held substrate, and said measuring electrode being electrically insulated from said substrate holding unit;

10 a measuring capacitor connected between said measuring electrode and a ground potential portion, said measuring capacitor having an electrostatic capacity C_m ;

 a voltage measuring unit for measuring a measuring voltage V_m between both ends of said measuring capacitor; and

15 a calculating unit for calculating said charging voltage V_s in accordance with a following numerical expression 1 or its mathematically equivalent numerical expression on the basis of an inverse K of a voltage dividing ratio that is defined by the relation of said electrostatic capacities C_s and C_m and
20 said measuring voltage V_m .

[Numerical expression 1]

$$V_s = K \times V_m$$

where $K = (C_s + C_m) / C_s$ or $K = C_m / C_s$ (if $C_m \gg C_s$)

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2. A charging voltage measuring device apparatus for measuring a charging voltage V_s on the surface of a substrate held on a substrate holding unit, comprising:

5 a measuring electrode, for forming an electrostatic capacity C_s with said substrate, being disposed on said substrate holding unit to make contact with or proximate to the back face of said held substrate, and said measuring electrode being electrically insulated from said substrate holding unit;

10 a measuring capacitor connected between said measuring electrode and a ground potential portion, said measuring capacitor having an electrostatic capacity C_m ;

a voltage measuring unit for measuring a measuring voltage V_m between both ends of said measuring capacitor; and

15 a calculator calculating unit for calculating said charging voltage V_s at time t_1 in accordance with a following numerical expression 2 or its mathematically equivalent numerical expression on the basis of an inverse K of a voltage dividing ratio that is defined by the relation between said
20 electrostatic capacities C_s and C_m , and said measuring voltage $V_m(t_1)$ at time t_1 , and a resistance value R_m of a resistor including an internal resistor of said voltmeter and disposed in parallel to said measuring capacitor, when the time is t , the measurement start time is $t=0$, and the measurement time
25 is t_1 .

[Numerical expression 2]

$$V_s = K[V_m(t_1) + \{1/(C_m \times R_m)\} \int_0^{t_1} V_m(t) dt]$$

where $K = (C_s + C_m)/C_s$ or $K = C_m/C_s$ (if $C_m \gg C_s$)

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3. An ion beam irradiating device apparatus for irradiating an ion beam onto a substrate held on a substrate holding unit, comprising:

an plasma generating source for generating and
10 supplying electrons to said substrate to suppress the electrification on the surface of said substrate caused by irradiating said ion beam;

a charging voltage measuring device for the substrate according to claim 1; and

15 a controller unit for controlling an amount of electrons generated from said electron supply source on the basis of charging voltage V_s measured by said charging voltage measuring device;

wherein said control unit controls to maintain said
20 amount of said electrons generated from said electron supply source when said charging voltage V_s is within a reference voltage range,

wherein said control unit controls to increase said
amount of said electrons generated from said electron supply
25 source when said charging voltage V_s is higher than said

reference voltage range, and

wherein said control unit controls to decrease said amount of said electrons generated from said electron supply source when said charging voltage V_s is lower than said reference
5 voltage range.

4. An ion beam irradiating apparatus for irradiating an ion beam onto a substrate held on a substrate holding unit, comprising:

10 an plasma generating source for generating and supplying electrons to said substrate to suppress the electrification on the surface of said substrate caused by irradiating said ion beam;

a charging voltage measuring device for the
15 substrate according to claim 2; and

a control unit for controlling an amount of electrons generated from said electron supply source on the basis of charging voltage V_s measured by said charging voltage measuring device;

20 wherein said control unit controls to maintain said amount of said electrons generated from said electron supply source when said charging voltage V_s is within a reference voltage range,

wherein said control unit controls to increase said amount
25 of said electrons generated from said electron supply source

when said charging voltage V_s is higher than said reference voltage range, and

wherein said control unit controls to decrease said amount of said electrons generated from said electron supply source
5 when said charging voltage V_s is lower than said reference voltage range.

5. The charging voltage measuring device according to claim 1, wherein said measuring electrode is a conductive
10 plate covered with an insulating layer.

6. The charging voltage measuring device according to claim 2, wherein said measuring electrode is a conductive plate covered with an insulating layer.

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